REMARKS

Claims 1-32, 35-39, 41-61, 63-88, 91-97 are currently pending in the present application. Claims 1-97 were presented for examination. Claims 33-36, 40, 62, 89, and 90 have been cancelled by amendment.

In the office action mailed March 27, 2003 ("the Office Action"), the specification was object to for informalities. Claims 37 and 70 were also objected to for informalities. Claims 1-97 were rejected under 35 U.S.C. 102(e) as being anticipated by U.S. Patent No. 6,501,483 to Wong *et al.* ("the Wong patent").

With respect to the Examiner's objection to the specification, the amendments suggested by the Examiner were made to the specification to correct the objections. Additionally, claims 37 and 70 were also amended to overcome the objections noted by the Examiner.

The disclosed embodiments of the invention will now be discussed in comparison to the prior art. Of course, the discussion of the disclosed embodiments, and the discussion of the differences between the disclosed embodiments and the prior art subject matter, do not define the scope or interpretation of any of the claims. Instead, such discussed differences merely help the Examiner appreciate important claim distinctions discussed thereafter.

Embodiments of the present invention are directed to methods and systems for performing multi-sample, anti-aliased rendering of images. The value of a pixel of an image is computed from one or more sample values, each computed at a respective sample point, position, or location. The sampling points, positions, or locations for a pixel are arranged in a sampling pattern. Sample values for a pixel are combined to calculate a value for the pixel. In various embodiments of the present invention, different sampling patterns are applied to different pixels of the image. For example, in one embodiment, different sampling patterns may be applied to alternate pixels along lines parallel to a first axis and/or along lines parallel to a perpendicular second axis. In another embodiment, a repeating sequence of sampling patterns may be applied to consecutive pixels along a row or column. An alternative embodiment provides a sampling pattern having four sample locations within the region of a pixel. The four samples are arranged within the pixel region such that were the pixel region divided into a four-by-four array of sub-regions, the four sample locations would be arranged within the pixel region in a manner such

that no two samples are located in the same row, column, or diagonal of sub-regions. A sampling pattern can use only two or three of these four potential positions. In another embodiment of the present invention, a sampling pattern may be applied repeatedly to a pixel, and the sample values are taken for a pixel and combined and cumulated with previously calculated and stored values. Within a frame the same sampling pattern and the same sampling locations can be used each time a pixel is sampled in order to avoid introducing artifacts.

The Wong patent discloses methods and systems for anti-aliasing using a non-uniform pixel sampling pattern. Examples of the sampling patterns are provided in Figures 2A, 3A, 4A, 5A-5L, and 6A, of the Wong patent. The particular sampling patterns shown in these Figures are described at col. 4, line 3-col. 7, line 17. As disclosed in the Wong patent, the sampling patterns can be applied for anti-aliasing of an image. For example, as shown in Figure 2B, and described at col. 4, lines 31-65, the sampling pattern of Figure 2A is applied to all of the pixels of an image. Figure 2B shows nine pixels of an image arranged in a 3x3 pattern with the sampling pattern of Figure 2A applied to each of the nine pixels. As described in the Wong patent, although the sampling pattern of Figure 2A exhibits "a bias in favor of objects that extend into the upper left and lower right of the pixel area, the composite of multiple pixels in FIG. 2B does not necessarily exhibit such a bias." *See* col. 4, lines 37-40. That is, the sampling pattern of Figure 2A illustrates sampling points that for *one* pixel may not exhibit uniform sample values when an object overlaps the pixel. However, when the same sampling pattern is repeated for *each* pixel of an image formed from the *composite of the pixels*, then the particular sample points will exhibit much greater uniformity, and provide superior anti-aliasing effect. *See* col. 4, lines 40-65.

Alternative sampling patterns, one having six sample points (Figure 3A), and another having six sample points, but over a pixel region divided into 36 sub-regions instead of 16 sub-regions (Figure 4A), are also shown when applied to a composite of pixels (Figures 3B and 4B, respectively). That is, the sampling patterns shown in Figures 3A and 4A are applied to a composite of pixels to demonstrate that greater uniformity can be achieved when the particular sampling pattern is repeated for each pixel of an image. As described in the Wong patent, "although the super-sampling at the pixel level is non-uniform (FIGS. 3A, 4A), the super-

sampling pattern relative to an arrangement of multiple pixels is substantially uniform (FIGS. 3B, 4B)." *See* col. 5, lines 8-11.

The Wong patent further describes that the resulting sampling patterns of Figures 3A and 3B exhibit varying horizontal and vertical sampling frequency. Although the same sample pattern is applied to each of the pixels, and the number of sample points in each pixels are the same, the total number of sample points overlapping an edge of an object as it passes over the pixels does not change consistently, and as a result, can produce non-uniform changes in the pixel color. *See* col. 5, lines 21-45. The Wong patent mentions that if a non-uniform pixel change is objectionable, the sampling pattern shown in Figures 4A and 4B can be applied to provide a uniform sampling frequency for object changes or motions in the horizontal and vertical directions. *See* col. 5, lines 49-57.

The Wong patent further describes 24 sampling patterns (*i.e.*, the 12 sampling patterns of Figures 5A-5L, plus the "inverted" patterns for each of those) with respect to Figures 5A-5L at col. 6, lines 2-8, that have uniform horizontal an vertical sampling frequencies. The "inverted" sampling pattern of Figure 5A is applied to a composite of pixels, as shown in Figures 6A and 6B. With respect to the sample pattern of Figures 6A and 6B, the Wong patent discusses that although a uniform horizontal and vertical sample rate is provide by the particular sample pattern, the sample frequency is not uniform in each of the diagonal directions. That is, for an object in motion having an edge passing at an angle with respect to the arrangement of the pixels, the sampling frequency can be different. *See* col. 6, lines 19-65. The Wong patent suggests that if the uniform diagonal sampling frequency is desirable, then the sampling pattern that is applied to the composite of pixels should not be that shown in 6A.

As previously mentioned, claims 1-97 have been rejected under 35 U.S.C. 102(e) as being anticipated by the Wong patent.

Claim 1 is patentably distinct from the Wong patent. Claim 1 recites a method for calculating values for pixels of an image, comprising calculating sample values for pixels of an image in accordance with a sampling pattern for each pixel, the sampling pattern for consecutive pixels alternating between a first and a second sampling pattern, each sampling pattern defining one or more sampling locations at which sample values are calculated, the sampling locations

being relative to a pixel, and determining a value for at least one pixel by combining sample values calculated for the sampling locations for the pixel.

Claim 1 is patentably distinct from the Wong patent because the Wong patent fails to disclose the combination of limitations recited by claim 1. For example, the Wong patent does not disclose the sampling pattern for consecutive pixels alternating between a first and a second sampling patterns. As previously discussed, the Wong patent describes several different sampling patterns for a pixel region, as shown in Figures 2A, 3A, 4A, 5A-5L, and 6A. However, the same sampling pattern is repeated for each pixel of a composite of pixels, as shown in Figures 2B, 3B, 4B, and 6B. Alternating sampling patterns for pixels of an image is clearly not disclosed by the Wong patent. As described in the Wong patent, the sampling pattern of a pixel should be repeated for each pixel of a composite of pixels in order for a non-uniform sampling rate at the pixel level to have a substantially uniform sampling rate for a composite of pixels. For the foregoing reasons, claim 1 is patentably distinct from the Wong patent, and therefore, the rejection of claim 1 under 35 U.S.C. 102(e) should be withdrawn.

Claims 14 and 52 are also patentably distinct from the Wong patent. Claim 14 recites a method for generating an image having pixels arranged in rows and columns parallel to first and second perpendicular axes, respectively, the method comprising calculating pairs of sample values for pixels of the image in accordance with a plurality of sampling patterns, one sampling pattern per pixel, one pair of sampling points per sampling pattern, and calculating a value for at least one pixel of the image from a respective pair or pairs of calculated sample values. Claim 52 recites a method for calculating values for pixels of an image having pixels arranged in rows and columns parallel to first and second perpendicular axes, respectively, the method comprising calculating sample values for pixels of the image in accordance with a plurality of sampling patterns, and calculating values for pixels of the image from respective calculated sample values.

Claims 14 and 52 are patentably distinct from the Wong patent because the Wong patent fails to disclose the combination recited by claims 14 and 52. For example, the Wong patent fails to disclose calculating pairs of sample values for pixels of the image in accordance with a plurality of sampling patterns, one sampling pattern per pixel, one pair of sampling points per sampling pattern. The Wong patent further fails to disclose calculating sample values for

pixels of the image in accordance with a plurality of sampling patterns. As previously discussed with respect to claim 1, the Wong patent describes various sampling patterns for a pixel region that are applied to each pixel of a composite of pixels. In the Wong patent, for each application of a particular sampling pattern for a pixel region, the same sampling pattern is applied to each pixel of a composite of pixels. In contrast, the methods recited by claims 14 and 52 include as part of the combination calculating sample values for pixels of the image in accordance with a plurality of sampling patterns. For the foregoing reasons, claims 14 and 52 are patentably distinct from the Wong patent. Therefore, the rejection of claims 14 and 52 under 35 U.S.C. 102(e) should be withdrawn.

Claims 23 and 27 are also patentably distinct from the Wong patent. Claim 23 recites a method for calculating values for pixels of an image having the pixels arranged in rows and columns parallel to first and second perpendicular axes, respectively, the method comprising calculating sample values for pixels of the image in accordance with a plurality of sampling rates, the sampling rate differing for at least two pixels of the image, and calculating values for pixels of the image from respective calculated sample values. Claim 27 recites a method for calculating values for pixels of an image having the pixels arranged in rows and columns parallel to first and second perpendicular axes, respectively, the method comprising calculating sample values for pixels of the image in accordance with first and second sampling rates, the sampling rate remaining constant for consecutive pixels arranged along any one given line parallel to the first axis and varying between the first and second sampling rates for consecutive pixels arranged along any one given line parallel to the second axis, and calculating values for pixels of the image from respective calculated sample values.

The Wong patent fails to disclose the combination of limitations recited in claims 23 and 27. For example, the Wong patent does not disclose calculating sample values for pixels of the image in accordance with a plurality of sampling rates, the sampling rate differing for at least two pixels of the image. The Wong patent also fails to disclose calculating sample values for pixels of the image in accordance with first and second sampling rates, the sampling rate remaining constant for consecutive pixels arranged along any one given line parallel to the first axis and varying between the first and second sampling rates for consecutive pixels arranged along any one given line parallel to the second axis. The Wong patent describes applying the

sampling patterns disclosed therein for each pixel of a composite of pixels. As described in the Wong patent, by applying the sampling pattern of a pixel region to every pixel of a composite of pixels, a substantially uniform sampling rate can be achieved. This is in contrast to the limitations recited in claims 23 and 27, for example, using multiple sampling rates for the pixels of an image. For the foregoing reasons, claims 23 and 27 are patentably distinct from the Wong patent. Consequently, the rejection of claims 23 and 27 under 35 U.S.C. 102(e) should be withdrawn.

Claim 37 is also patentably distinct from the Wong patent. Claim 37 recites a method for calculating values for pixels of an image, comprising calculating sample values for pixels of the image in accordance with a sampling pattern for each pixel, the sampling pattern varying per pixel between a first and a second sampling pattern, each pattern having four sample locations relative to a pixel, the region of potential sampling locations considered as evenly divided into a four-by-four array of sub-regions and the four sample locations arranged in a manner whereby no two of the four sample locations from a given sampling pattern are located along the same row, column, or diagonal of sub-regions, and determining a value for at least two pixels by combining sample values calculated for the sampling locations for the pixel.

The Wong patent fails to disclose the combination of limitations recited by claim 37. For example, the Wong patent fails to disclose calculating sample values for pixels of the image in accordance with a sampling pattern for each pixel, the sampling pattern varying per pixel between a first and a second sampling pattern. As previously discussed with respect to claims 1, 14, 23, 27, and 52, the Wong patent discloses application of the same sampling pattern for each pixel of a composite of pixels, and does not disclose varying per pixel between a first and second sampling pattern, as recited as part of the combination of claim 37. For the foregoing reasons, claim 37 is patentably distinct from the Wong patent. Therefore, the rejection of claim 37 under 35 U.S.C. 102(e) should be withdrawn.

Claim 41 is also patentably distinct from the Wong patent because the Wong patent fails to disclose each limitation of the combination of limitations recited by claim 41. Claim 41 recites A method for calculating values for pixels of an image having its pixels arranged in rows and columns parallel to first and second perpendicular axes, respectively, the method comprising calculating sample values for pixels of the image in accordance with one or

more sampling patterns, the region of potential sampling locations relative to a pixel considered as divided evenly into a four-by-four array of sub-regions each sampling pattern having at least two sample locations relative to a pixel, each sample location located at one of four candidate sampling locations, and the candidate sampling locations arranged in a manner whereby no two of the four candidate sample locations for a given sampling pattern are located along the same row, column, or diagonal of sub-regions, at least one sampling pattern including at least one other sampling location not located in one of the candidate sampling locations, no more than seven sub-regions containing any sampling location, and calculating values for pixels of the image from sample values calculated for respective pixels. In addition to the deficiencies of the Wong patent previously discussed with respect to claims 1, 14, 23, 27, 41, and 52, the Wong patent fails to disclose at least the limitation of at least one sampling pattern including at least one other sampling location not located in one of the candidate sampling locations, no more than seven sub-regions containing any sampling location. For the foregoing reasons, claim 41 is patentably distinct from the Wong patent and the rejection of claim 41 under 35 U.S.C. 102(e) should be withdrawn.

Claim 42 is also patentably distinct from the Wong patent. Claim 42 recites a method for calculating values for pixels of an image having its pixels arranged in rows and columns parallel to first and second perpendicular axes, respectively, the method comprising calculating sample values for pixels of the image in accordance with a sampling pattern, the region of potential sampling locations relative to a pixel considered as divided evenly into a four-by-four array of sub-regions, the sampling pattern having two sample locations relative to a pixel, each sample location located at one of four candidate sampling locations, and the candidate sampling locations arranged in a manner whereby no two of the four candidate sample locations for a given sampling pattern are located along the same row, column, or diagonal of sub-regions, and calculating values for pixels of the image from sample values calculated for respective pixels.

Claim 42 is patentably distinct from the Wong patent because the Wong patent fails to disclose each limitation of the combination of limitations recited by claim 42. For example, the Wong patent fails to describe any sampling patterns having two sample locations relative to a pixel, each sample location located at one of four candidate sampling locations, and

the candidate sampling locations arranged in a manner whereby no two of the four candidate sample locations for a given sampling pattern are located along the same row, column, or diagonal of sub-regions. The Wong patent describes sampling patterns that have at least four samples per pixel region, except for the prior art, where there is only one sample point for a pixel region. For the foregoing reason, claim 42 is patentably distinct from the Wong patent, and the rejection of claim 42 under 35 U.S.C. 102(e) should be withdrawn.

Claim 49 is patentably distinct from the Wong patent. Claim 49 recites a method for calculating values for pixels of an image having pixels arranged in rows and columns parallel to first and second perpendicular axes, respectively, the method comprising calculating sample values for pixels of the image in accordance with a plurality of sampling patterns, each pixel in the image having an associated sampling pattern, the sampling patterns associated with the pixels of a first group of horizontally or vertically consecutive pixels being repeated for at least one following group of the same number of pixels, the same sequence of patterns appearing within at least one following group, and calculating a final value for a pixel of the image from respective calculated sample values. The Wong patent fails to disclose at least the limitation calculating sample values for pixels of the image in accordance with a plurality of sampling patterns, each pixel in the image having an associated sampling pattern. The Wong patent also fails to disclose that the sampling patterns associated with the pixels of a first group of horizontally or vertically consecutive pixels is repeated for at least one following group of the same number of pixels, the same sequence of patterns appearing within at least one following group. The Wong patent discloses applying the same sample pattern of a pixel region for each pixel of a composite of pixels, unlike the limitations recited in claim 49. For the foregoing reasons, claim 49 is patentably distinct from the Wong patent, and consequently, the rejection of claim 49 under 35 U.S.C. 102(e) should be withdrawn.

Claims 63 and 64 are patentably distinct from the Wong patent as well. Claim 63 recites a method for calculating values for pixels of an image having pixels arranged in rows and columns parallel to first and second perpendicular axes, respectively, the method comprising calculating sample values for pixels of the image in accordance with a fixed set of sampling patterns stored in a read-only memory, the sampling pattern for a given pixel determined by a calculation based upon the row and/or column containing the pixel, and calculating values for

pixels of the image from respective calculated sample values. Claim 64 recites a method for calculating values for pixels of an image having pixels arranged in rows and columns parallel to first and second perpendicular axes, respectively, the method comprising calculating sample values for pixels of the image in accordance with a fixed set of sampling patterns stored in a read-only memory, selecting one sampling pattern from the set of sampling patterns to be applied for calculating sample values for a given pixel; and calculating values for pixels of the image from respective calculated sample values.

The Wong patent fails to disclose each of the limitations of the combination of limitations recited by claims 63 and 64. For example, claim 63 recites, among other things, that the sampling pattern for a given pixel is determined by a calculation based upon the row and/or column containing the pixel, and claim 64 recites, among other things, that the sample values for pixels of the image are calculated in accordance with a fixed set of sampling patterns stored in a read-only memory, and that one sampling pattern is selected from the set of sampling patterns to be applied for calculating sample values for a given pixel. The Wong patent does not disclose any of these limitations. For the foregoing reasons, claims 63 and 64 are patentably distinct from the Wong patent. Therefore, the rejection of claims 63 and 64 under 35 U.S.C. 102(e) should be withdrawn.

Claim 70 is also patentably distinct from the Wong patent. Claim 70 recites a method for calculating values for pixels of an image having the pixels arranged in rows and columns parallel to first and second perpendicular axes, respectively, the method comprising shifting the sampling locations defined by one or more sampling patterns relative to a pixel, calculating sample values for at least one pixel in accordance with the shifted sampling locations of a respective sampling pattern, and calculating values for pixels from respective calculated sample values. The Wong patent fails to describe any shifting of the sampling locations for calculating sample values using the shifted sample locations. As previously discussed, the Wong patent describes several sampling patterns for a pixel region, however, the same sampling pattern for a pixel is applied to each pixel of a composite of pixels. Thus, the Wong patent does not discuss any shifting of sampling patterns, as recited in claim 70. For the foregoing reasons, claim 70 is patentably distinct from the Wong patent, and therefore, the rejection of claim 70 under 35 U.S.C. 102(e) should be withdrawn.

Claims 86, 87, and 91-93 are patentably distinct from the Wong patent. Claim 86 recites an apparatus for rendering of an image having pixels arranged in rows and columns parallel to first and second perpendicular axes, respectively, the apparatus sampling at a plurality of sample locations relative to a pixel in accordance with a sampling pattern, the sampling pattern for a pixel alternating per pixel between first and second sampling patterns for consecutive pixels arranged along any given line parallel to the first axis and/or for consecutive pixels arranged along any given line parallel to the second axis, the apparatus further calculating values for pixels of the image from respective sample values.

Claim 87 recites an apparatus for rendering of an image having pixels arranged in rows and columns parallel to first and second perpendicular axes, respectively, the apparatus sampling pixels in accordance with at least one sampling pattern having two sample locations, the apparatus further cumulating sample values from and to stored sample values corresponding to the same sampling locations for finally calculating a value for a pixel from a respective pair of stored cumulated sample values.

Claim 91 recites an apparatus for rendering of an image having pixels arranged in rows and columns parallel to first and second perpendicular axes, respectively, the apparatus calculating sample values for pixels in accordance with first and second sampling rates, the sampling rate remaining constant for consecutive pixels arranged along any given line parallel to the first axis and the sampling rate varying between the first and second sampling rates for consecutive pixels arranged along any given line parallel to the second axis, the apparatus further calculating values for the pixels of the image from the respective sample values.

Claim 92 recites an apparatus for rendering of an image having pixels arranged in rows and columns parallel to first and second perpendicular axes, respectively, the apparatus sampling pixels in accordance with a sampling pattern having four sample locations, the four sample locations arranged relative to a pixel within a region of potential sampling locations in a manner where no two sample locations are located in the same row, column, or diagonal of sub-regions where the region of potential sampling locations is considered as evenly divided into a four-by-four array of sub-regions, the apparatus further cumulating sample values from and to stored sample values corresponding to the same sampling locations for calculating a value for a pixel from respective sample values.

Claim 93 recites an apparatus for calculating values for pixels of an image, the apparatus comprising a first calculating means for calculating sample values at a plurality of sample locations relative to a pixel in accordance with a sampling pattern per pixel, the sampling pattern for a pixel alternating per pixel between a first and second sampling pattern for consecutive pixels arranged along any given line parallel to a first axis of the image and/or for consecutive pixels arranged along any given line parallel to a perpendicular second axis, a second calculating means for calculating values for pixels by combining respective sample values, a third calculating means for cumulating sample values, and a memory means coupled to the first, second, and third calculating means for storing and retrieving cumulated sample values for respective pixels.

The Wong patent fails to disclose the combination of limitations recited by claims 86, 87, and 91-93. For example, the Wong patent fails to disclose an apparatus sampling at a plurality of sample locations using sampling patterns alternating per pixel between first and second sampling patterns for consecutive pixels arranged along any given line parallel to the first axis and/or for consecutive pixels arranged along any given line parallel to the second axis. The Wong patent further fails to disclose an apparatus that cumulates sample values from and to stored sample values corresponding to the same sampling locations for finally calculating a value for a pixel from a respective pair of stored cumulated sample values. The Wong patent also fails to disclose an apparatus that calculates sample values for pixels using first of second sampling rates, or using a sampling rate that remains constant for consecutive pixels arranged along any given line parallel to the first axis and using a sampling rate that varies between the first and second sampling rates for consecutive pixels arranged along any given line parallel to the second axis. As previously discussed, the Wong patent discloses a process of applying the same sample pattern for each pixel of a composite of pixels. A reason for this approach is to take a sample pattern having a non-uniform sample rate at the pixel-level and apply it to a composite of pixels to result in a substantially uniform sample rate. For the foregoing reasons, claims 86, 87, and 91-93 are patentably distinct from the Wong patent. Therefore, the rejection of claims 86, 87, and 91-93 under 35 U.S.C. 102(e) should be withdrawn.

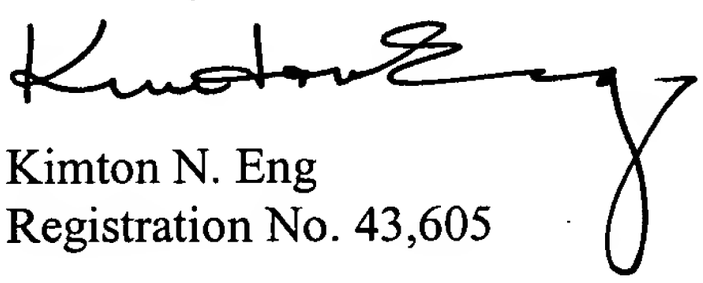
Claims 2-13, which depend from claim 1, claims 15-22, which depend from claim 14, claims 24-26, which depend from claim 23, claims 28-32, which depend from

claim 27, claims 38 and 39, which depend from claim 37, claims 43-48, which depend from claim 42, claims 50 and 51, which depend from claim 49, claims 53-61, which depend from claim 52, claims 65-69, which depend from claim 64, claims 71-85, which depend from claim 70, claim 88, which depends from claim 87, and claims 94-97, which depend from claim 93, are also patentably distinct from the Wong patent. That is, each of the dependent claims further narrows the scope of the claim from which it depends, and consequently, if a claim is dependent from an allowable base claim, the dependent claim is also allowable. However, because each claim in an application represents a different invention, the rejection of an independent claim does not necessarily result in the rejection of claims depending therefrom. For the foregoing reasons, the rejection of claims 2-13, 15-22, 24-26, 28-32, 38, 39, 43-48, 50, 51, 53-61, 65-69, 71-85, 88, and 94-97 under 35 U.S.C. 102(e) should be withdrawn.

All of the claims remaining in the application are now clearly allowable. Favorable consideration and a Notice of Allowance are earnestly solicited.

Respectfully submitted,

DORSEY & WHITNEY LLP



Kimton N. Eng
Registration No. 43,605

KNE:asw

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1420 Fifth Avenue, Suite 3400
Seattle, WA 98101-4010
(206) 903-8800 (telephone)
(206) 903-8820 (fax)